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bisector (prolonged) $\frac{bk^2}{k^2-b^2}$ from the vertex and a radius $R=\frac{b^2k}{k^2-b^2}$. The ends of the base move around this circle, the base itself always being a chord passing through a point whose distance from the center is $\frac{b^2k-k^2b+b^3}{k^2-b^2}$. The maximum length of the third side is of course the diameter of this circle $=\frac{2b^2k}{k^2-b^2}$ and the minimum length when the side is at right angles to the bisector $=2\sqrt{k^2-b^2}$.

The area swept through consists of two right triangles with a common hypotenuse and sides k and R $\left(\text{areas}=\frac{b^2k^2}{k^2-b^2}\right)$ and of a sector of circle R with angle at the center $=180^\circ+2\theta\left[\text{Area}=\frac{\pi b^2k(180+2\theta)}{360(k^2+b^2)}\right]$.

The numerical values are as follows:

Maximum Area $=b\sqrt{k^2-b^2}=1200\sqrt{6}=2939.38$.

Greatest length base $=2R=\frac{2b^2k}{k^2-b^2}=163.246$.

Total area swept over $=4899+9022=13921$.

Also solved by *C. W. M. Black*, *A. H. Bell*, *J. F. W. Scheffer*, *G. B. M. Zerr*. *W. B. Riegner*, of Philadelphia, sent a slip showing an excellent geometrical construction of this problem.

4. Proposed by J. M. COLAW, Principal of High School, Monterey, Virginia.

Three towns A, B, and C are in the same straight line. The distance from A to B is 20 miles and the distance from B to C is 80 miles. A pedestrian started from B for C and traveled at the variable rate of 10 miles an hour reciprocally as the cube root of his distance from A. In what time did he travel from B to C?

Solution by Professor P. H. PHILBRICK, M. S., C. E., Lake Charles, Louisiana, and P. S. BERG, Apple Creek, Ohio.

Let P, distant x from B, be his position at the end of time t.

Then, his velocity at P is $\frac{10}{\sqrt[3]{20+x}}$, and $\frac{dx}{dt}=\frac{10}{\sqrt[3]{20+x}}$,

$$dt=\frac{\sqrt[3]{20+x}}{10}dx\,,\quad t=\tfrac{1}{10}\int_0^{80}\sqrt[3]{20+x}\,dx$$

$$=\tfrac{3}{40}\left[(20+x)^{\frac{4}{3}}\right]_0^{80}\quad=\tfrac{3}{40}\left[(100)^{\frac{4}{3}}-(20)^{\frac{4}{3}}\right]$$

$=30.74+$ hours.

Solved by Professors *Hoover*, *Hume*, *Scheffer*, *Whitaker*, and *Finkel*.

5. Proposed by CHARLES E. MYERS, Canton, Ohio.

The volume generated by the curve whose equation is $y^2=px$, revolving about its axis, is cut by a right cylinder whose equation is $y^2=px-x^2$, the axis of the latter passing through the focus of the former. Find the volume common to both by the formula $V=\int\int\int dxdydz$.

I. Solution by Professor G. B. M. ZERR, A. M., Principal of Schools, Staunton, Virginia.

$y^2+z^2=2px$ is the equation of the paraboloid. The limits of z are

$\sqrt{2px-y^2}=z'$ and $-\sqrt{2px-y^2}=z''$. The limits of y are $\sqrt{px-x^2}-y'$ and $-\sqrt{px-x^2}=y''$. The limits of x are o, and p.

$$\therefore\ V=\int_o^p\int_{y''}^{y'}\int_{z''}^{z'}dxdydz=2\int_o^p\int_{y''}^{y'}\sqrt{2px-y^2}\,dxdy,$$

$$=2\int_o^p\left(x\sqrt{p^2-x^2}+2px\sin^{-1}\sqrt{\frac{p-x}{2p}}\right)dx$$

$$=2\left[-\tfrac{1}{3}\sqrt{(p^2-x^2)^3}+px^2\sin^{-1}\sqrt{\frac{p-x}{2p}}-\tfrac{1}{4}px\sqrt{p^2-x^2}+\tfrac{1}{4}\ p^3\sin^{-1}\frac{x}{p}\right]_o^p$$

$$=2p^3\left(\frac{1}{3}+\frac{\pi}{8}\right)=\tfrac{1}{12}p^3(8+3\pi).$$

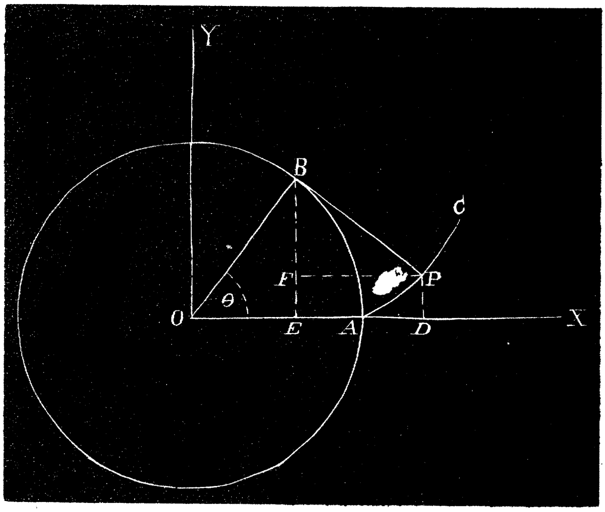
Also solved by *Professor Hume* and the *Proposer*.

6. Proposed by O. S. KIBLER, Superintendent of Schools, West Middleburg, Ohio.

A string is wound spirally twenty times around a cylinder 20 feet high and 2 feet in diameter. Through what distance will a dove fly in unwinding the string keeping it tense at all times (1) flying in the same plane and (2) not flying in the same plane?

Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi, University P. O., Mississippi.

Let the circle whose center is O and the curve AC be, respectively, the horizontal projections of the vertical cylinder and the dove's path.



Let P be any point of AC and A the original position of that end of the string to which the dove is attached.

Case I: THE DOVE FLYING IN ONE PLANE.

AC will be the involute of the circle. Denoting the angle AOB by θ and OA by a, $BA=a\theta=BP$.

The co-ordinates of P refered to axes as shown in the figure are,

$x=OD=OE+FP=a\cos\theta+a\theta\sin\theta$, $y=PD=BE-BF=a\sin\theta-a\theta\cos\theta$.

Therefore, $dx=(-a\sin\theta+a\theta\cos\theta+a\sin\theta)d\theta=a\theta\cos\theta d\theta$.

$dy=(a\cos\theta+a\theta\sin\theta-a\cos\theta)d\theta=a\theta\sin\theta\ d\theta$.

$ds^2=dx^2+dy^2=a^2\theta^2d\theta^2$; $ds=a\theta d\theta$; $s=\int a\theta d\theta=a\frac{\theta^2}{2}$, s being estimated from A.

$a=1$, and the θ-limits are 40π and 0. $\therefore$ $s=800\pi^2=7895$ feet, approximately.

Case II: THE STRING BEING KEPT HORIZONTAL.

BP, now, is the length of that part of the string unwound. Hence, BP is the hypotenuse of aright triangle whose base is the arc AB and whose altitude is